

# Graphs and Trees

Lecture 13 CPSC 533C, Fall 2005

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## Hermann survey

true survey, won't try to summarize here

nice abstraction work by authors

- Strahler skeletonization
- ghosting, hiding, grouping



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## Topic Presentations

material

- 1 paper from my suggestions
- 1 paper found on your own (same topic)

talk: 20 min each

- slides required
- critical points of papers
- comparison and critique not just outline

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## Graphs and Trees

Hermann survey

Graph Visualization in Information Visualization, S. Sawyer, Van Herman, Guy Melanson, M. Scott Marshall, IEEE Transactions on Visualization and Computer Graphics, 6(1), pp. 24-44, 2000. <http://citeseer.ri.jhu.edu/doc/10000/herman00graph.html>

Animated Radial Layouts

Animated Exploration of Graphs with Radial Layouts, Ka-Ping Yee, Danyel Fisher, Rachna Dhamija, and Marti Hearst, Proc. InfoVis 2001. <http://halbando.sims.berkeley.edu/papers/infovis01.htm>

SpaceTree

SpaceTree: Supporting Exploration in Large Node-Link Trees, Design Evolution and Empirical Evaluation, Catherine Plaisant, Jesse Crockett, and Ben B. Bederson, Proc. InfoVis 2002. <http://ftp.columbiadatepub.hill/Reports-Abstracts-Bibliography/2002-09/InfoVis/2002-09.pdf>

Cushion Treemaps

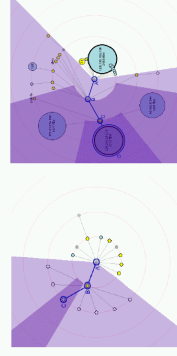
Cushion Treemaps, Jock MacWife and Huub van de Wetering, Proc. InfoVis 1999, pp. 73-79. <http://www.wmware.fr/~samwif/ctm.pdf>

Multiscale Small-World Graphs

Multiscale Visualization of Small World Networks, David Abate, Yves Chiriac, Fabien Fouard, Guy Melanson, Proc. InfoVis 2003. <http://davep-info.jhu.edu/~yabate/documents/publi/abate03small.pdf>

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## Animated Radial Layouts



[Animated Exploration of Graphs with Radial Layout.  
Ka-Ping Yee, Danyel Fisher, Rachna Dhamija, and Marti Hearst, Proc. InfoVis 2001.  
<http://halbando.sims.berkeley.edu/papers/infovis01.htm>]

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## Dynamic Graph Layout

static radial layouts: known algorithm

dynamic: little previous work

- DynaDAG [North, Graph Drawing 95]
- DA-TU [Huang, Graph Drawing 98]

minimize visual changes  
stay true to current dataset structure

[video]

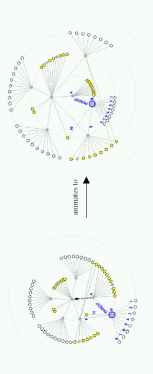
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## Animation

polar interpolation



maintain neighbor order



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## More Dynamic Graphs

[video]

Dynamic Drawing of Clustered Graphs  
Yaniv Frishman, Ayellet Tal  
InfoVis 2004 Video Proceedings

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## SpaceTree

focus+context tree  
· animated transitions



semantic zooming

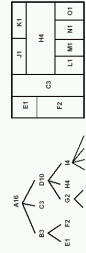


[demo]

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## Treemaps

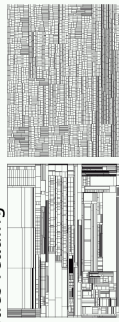
containment not connection



Node and link diagram

Treemap

difficulties reading

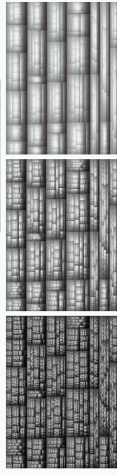
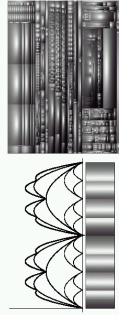


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## Cushion Treemaps

show structure with shading

· scale parameter controls global vs. local



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## Cushion Treemaps

application

- SequoiaView, Windows app
- hard drive usage
- <http://www.win.tue.nl/sequoiaview/>

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## Small-World Networks

high clustering, small path length  
 · vs. random uniform distribution

### examples

- social networks
- movie actors
- Web
- software reverse engineering

### multiscale small-world networks

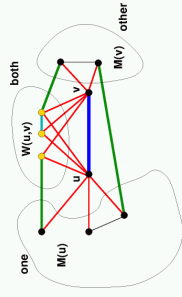
- exploit these properties for better layout

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## Strength Metric

strength: contribution to neighborhood cohesion

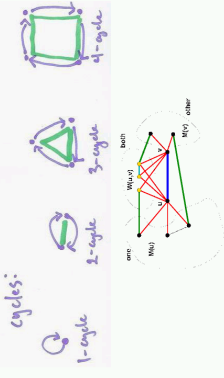
calculate for each edge based on edge's POV partition of graph: one, other, both



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## Strength via Cycles

3-cycles through  $(u,v)$  + 4-cycles through  $(u,v)$

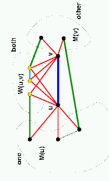


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## Cycles: Cohesion Measure

3-cycles through  $u/v$

- blue + 2 red edges == yellow nodes in both



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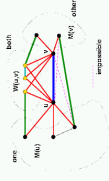
## Cycles: Cohesion Measure

3-cycles through  $u/v$

- blue + 2 red edges == yellow nodes in both

all other 3-cycles don't contain blue  $u/v$  edge

- magenta edges impossible
- black, red/green, red/black, etc



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## Cycles: Cohesion Measure

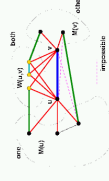
3-cycles through  $u/v$

- blue + 2 red edges == yellow nodes in both

existing

yellow nodes

- all possible

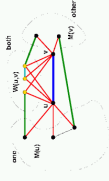


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## Cycles: Cohesion Measure

- 4-cycles through  $u/v$
- blue + 2 red + 1 green
  - blue + 2 red + 1 cyan

$$s(A,B) = \begin{cases} \text{existing edges between sets} \\ \text{all possible edges between sets} \end{cases}$$

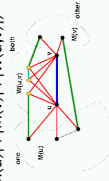


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## Strength

- 4-cycles [green edges]
- one-both, other-both, one-other
  - $s(M(u),W(u,v)) + s(M(v),W(u,v)) + s(M(u),M(v))$
- 4-cycles [cyan edges]
- both-both
  - $s(W(u,v))$

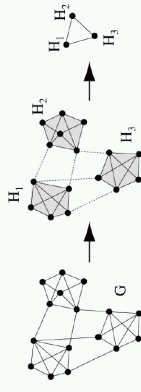
- 3-cycles [yellow nodes in both]
- $|W(u,v)| / (|M(u)| + |M(v)| + |W(u,v)|)$



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## Hierarchical Decomposition

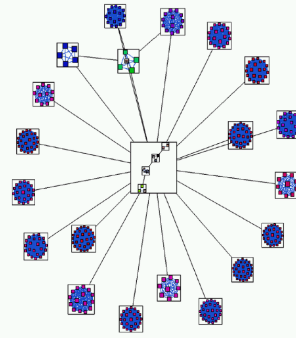
- remove low-strength edges
- maximal disconnected subgraphs
- quotient graph: subgraph = higher-level node



Multiscale Visualization of Small World Networks, Auber, Chircioaia, Jourdain, and Melancon. Proc. InfoVis 2003

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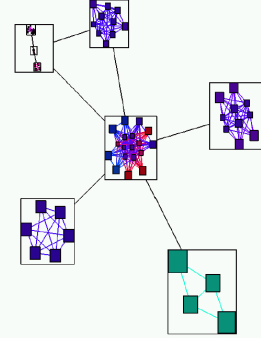
## Nested Quotient Graphs



Multiscale Visualization of Small World Networks, Auber, Chircioaia, Jourdain, and Melancon. Proc. InfoVis 2003

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## Nested Quotient Graphs

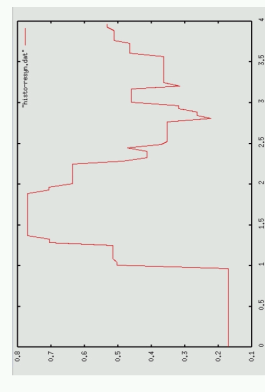


Multiscale Visualization of Small World Networks, Auber, Chircioaia, Jourdain, and Melancon. Proc. InfoVis 2003

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## Clustering Quality Metric

automatically determine how many clusters



Multiscale Visualization of Small World Networks, Auber, Chircioaia, Jourdain, and Melancon. Proc. InfoVis 2003

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## Critique

### PROS

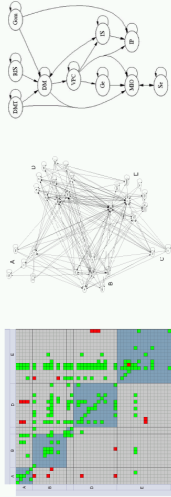
- exploit structure of data
- hierarchical structure shown visually
- automatically determine number of clusters
- nifty math

### CONS

- information density could be better
- what if mental model doesn't match clustering metric?

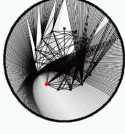
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## Previous: Multilevel Call Matrices



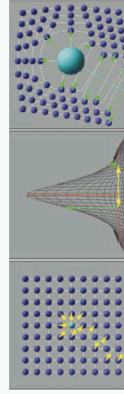
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## Previous: EdgeLens



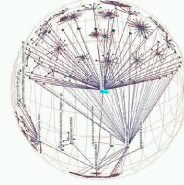
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## Previous: Visual Access Distortion



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## Previous: H3



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## Previous: TJ

